Summary.

If the sphere be divided into equal-surface zones of galactic latitude, the distribution of the poles of the orbits according to the above results would be as follows :

Number of Poles in each Zone.

Zone of Galactic Latitude.	A. When, for each Star, the orbit corresponding to the pole of lesser latitude is taken.	B. When, for each Star, the orbit corresponding to the pole of greater latitude is taken.	Mean of numbers in two preceding columns. $\frac{A+B}{2}$.
0°–11°	19	4	11½
12–23	13	5	9
24–37	13	11	12
37–53	8	11	9½
53–90	2	24	13

If we consider only stars lying not far from the Milky Way, say, for example, those whose galactic latitude is under 40°, then these numbers become :

Number of Poles in each Zone.

Zone of Galactic Latitude.	A.	B.	Mean of numbers in two preceding columns. $\frac{A+B}{2}$.
0°–11°	10	2	6
12–23	8	4	6
24–37	11	8	9½
37–53	5	7	6
53–90	1	14	7½

Kgl. Astrophysikalisches Observatorium zu Potsdam : 1896 *June.*

On the Corrections to the Right Ascensions of Stars derived from Observations of the Sun made at Greenwich during the years 1836–1895. By W. G. Thackeray.

If a comparison be made between the values of the proper motions in right ascension for the fundamental stars as given by Professor Newcomb in his standard right ascensions, and by Dr. Auwers from his re-reduction of Bradley's observations, it will be found that Professor Newcomb's proper motions are on the average nearly $^{s}\cdot001$ larger than those given by Dr. Auwers. It would therefore seem that the epoch correction of one or other

of these systems of right ascensions must be in error, as they both used Struve's precession.

Professor Newcomb in *A. J.* No. 359, in a paper "On the Value of the Precessional Constant," has shown that, if Δa be assumed to be the correction to the centennial motion of the equinox in R.A. as determined by Auwers Bradley in 1755 and by Pulkova in 1855, a comparison with 97 time stars of the American ephemeris, taking as the basis of comparison his own system of right ascensions as found in the Catalogue of vol. i. of the *Astronomical Papers*, and reproduced in the American ephemeris for the years 1881–1899 gives—

$$\Delta a = + 0^{s}.120.$$

Now the Auwers-Bradley's proper motions and the Struve-Peters's value of precession and the places of the stars in the Greenwich Five-Year Catalogue, 1890, constitute the basis of the present Greenwich clock-star lists, and this paper discusses the adoption of this system as a standard and deduces the correction given by the observations of the Sun for the years 1836–1895, with the result that referred the centennial variation $= +0^{s}.132$ to 1880.

From 1836–1852 the clock-star list contained 62 stars, which was increased by the addition of some 90 stars in 1853 to about 150 stars. Further small additions were made from time to time, till in 1859 the list comprised some 190 stars, and at the present time the number of stars has increased to 210.

In order to obtain the necessary correction to the adopted clock-star list places as given in the Introductions to the several volumes of Greenwich observations, the Five-Year Catalogue place of each clock-star has been reduced with Auwers' proper motions and Struve's precession for every year from 1836–1848 and compared with the adopted clock-star place for the year, and the corresponding corrections thus found have been multiplied by weights proportional to the number of observations of each star made in each year, and the sum of all these products divided by the number of the weights has been assumed to be the general correction to the clock-star system in use for each of these years, and therefore the general corrections to the observations of the Sun for that year.

After the year 1848, when the system of making the clock-star list depend on a definite catalogue place was inaugurated, it has been assumed that the mean correction given by all the clock-stars by direct comparison with the Five-Year Catalogue, 1890, reduced to the various epochs of the different catalogues upon which the different clock-star lists depend, constituted the proper correction to be applied to the year's observations as long as the same Catalogue was in use. The legitimacy of this assumption has been verified by finding the actual corrections to the clock errors on each day when the Sun was observed during

the four years 1836, 1841, 1843, and 1846 (chosen at random), deducing the actual correction to the tabular right ascension and the ecliptic north polar distance, and inserting the corrections in the corresponding equations of the discussion of the position of the ecliptic as given in the volume of Greenwich observations.

The following table gives the corrections to the tabular errors of right ascension of the Sun and the corresponding corrections to the ecliptic north polar distance for each month of the four above-named years with the weights used in the equations for the discussion of the position of the ecliptic.

TABLE I.

Corrections to tabular errors of the Sun in right ascension and ecliptic north polar distance to refer the observation of the Sun to a standard system of clock-stars based on the Greenwich Five Year Catalogue, 1890, Auwers-Bradley's proper motions and Struve-Peters precession.

Month.	1836			1841			1843			1846		
	Corr. to Tab. Error of Sun in R.A.	Corr. to E.N.P.D.	Weight.	Corr. to Tab. Error of Sun in R.A.	Corr. to E.N.P.D.	Weight.	Corr. to Tab. Error of Sun in R.A.	Corr. to E.N.P.D.	Weight.	Corr. to Tab. Error of Sun in R.A.	Corr. to E.N.P.D.	Weight.
	s	"		s	"		s	"		s	"	
Jan.	+·036	+·106	12	·000	·000	7	−·095	−·273	7	−·047	−·114	8
Feb.	+·042	+·194	12	+·007	+·029	8	−·082	−·448	11	−·058	−·288	9
Mar.	+·088	+·531	6	+·016	+·096	13	−·052	−·310	13	−·028	−·179	11
Apr.	+·066	+·367	5	+·030	+·159	9	−·072	−·366	12	−·021	−·107	8
May	+·021	+·067	14	+·003	+·010	10	−·109	−·317	10	−·065	−·232	6
June	+·012	+·003	11	+·018	+·014	9	−·073	+·036	9	−·060	−·057	13
July	+·013	−·021	12	+·013	−·040	6	−·086	+·248	7	−·067	+·193	12
Aug.	−·011	+·046	13	·000	·000	12	−·096	+·455	10	−·075	+·425	9
Sept.	−·003	·000	5	+·005	−·030	10	−·103	+·604	14	−·083	+·477	7
Oct.	+·043	−·218	9	−·013	+·063	9	−·096	+·537	15	−·059	+·333	6
Nov.	−·008	+·037	14	−·002	+·007	9	−·100	+·380	9	−·062	+·211	10
Dec.	+·014	−·068	7	−·010	+·005	10	−·108	+·179	7	−·075	+·024	11

Let Δx, Δy, be the corrections to the values of x and y previously deduced, then the corresponding equations from the discussions of the position of the ecliptic in the several volumes of Greenwich observations give for—

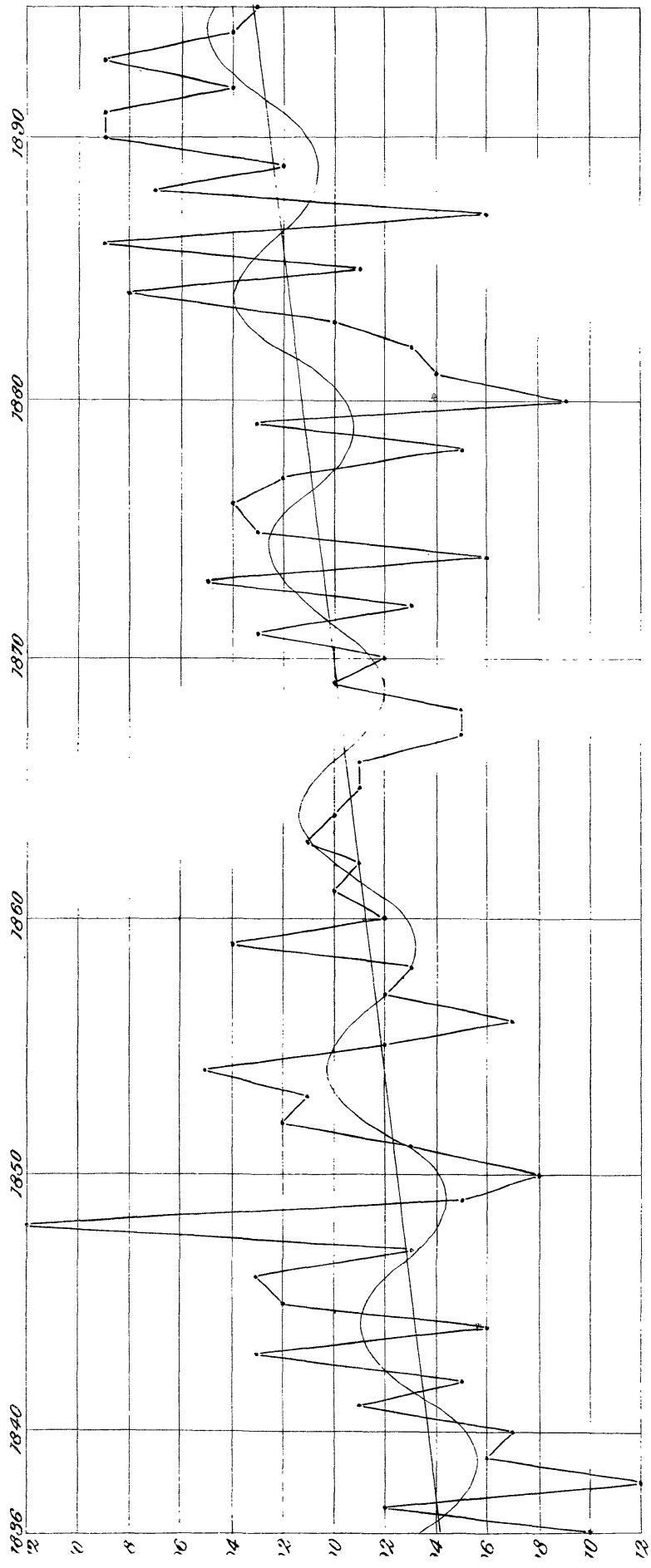
1836 $\left\{\begin{array}{l} 71{\cdot}12\,\Delta x + 7{\cdot}64\,\Delta y = +10{\cdot}726 \\ 9{\cdot}66\,\Delta x - 85{\cdot}26\,\Delta y = +2{\cdot}143 \end{array}\right\}$ whence $\Delta x = +0{\cdot}15$

1841 $\left\{\begin{array}{l} 73{\cdot}02\,\Delta x + 14{\cdot}20\,\Delta y = +2{\cdot}997 \\ 14{\cdot}31\,\Delta x - 69{\cdot}28\,\Delta y = +1{\cdot}043 \end{array}\right\}$ whence $\Delta x = +0{\cdot}04$

1843 $\left\{\begin{array}{l} 88{\cdot}33\,\Delta x + 18{\cdot}07\,\Delta y = -43{\cdot}797 \\ 14{\cdot}77\,\Delta x - 67{\cdot}81\,\Delta y = -3{\cdot}845 \end{array}\right\}$ whence $\Delta x = -0{\cdot}49$

1846 $\left\{\begin{array}{l} 66{\cdot}26\,\Delta x + 14{\cdot}13\,\Delta y = -22{\cdot}314 \\ 17{\cdot}16\,\Delta x - 71{\cdot}12\,\Delta y = -7{\cdot}591 \end{array}\right\}$ when $\Delta x = -0{\cdot}33$.

Corrections to Right Ascensions of Clock Stars referred to a uniform system from observations of the Sun, 1836–1895.



Dividing each of these quantities by 15 sin 23° 28′ we get the following corrections to the right ascension of the stars :

	Years	1836.	1841.	1843.	1846.
(1)	. . . .	+ˢ·025	+ˢ·007	−ˢ·081	−ˢ·055

the values previously adopted by weighting the corrections for each star proportionally to the number of observations made in each year was

(2)	. . . .	+ˢ·020	+ˢ·008	−ˢ·076	−ˢ·060

by taking the simple mean of all the corrections to all the clock-stars, and virtually assuming that the clock errors for the observations of the Sun are well distributed over the whole clock-star list in the course of the year, these quantities would be

(3)	. . . .	+ˢ·026	+ˢ·012	−ˢ·079	−ˢ·060

It would thus appear that the observations of the clock stars upon which the Sun observations in the course of a year depend seem to be well distributed over the whole list, or that the errors of the individual clock errors are of an accidental character, and in the main well determined. In any case it does not appear that the method (2) or (3) of finding the correction to the adopted results of the Sun observations can introduce any sensible error, especially as we are adopting in the final results only two places of decimals, and also considering the large accidental errors evidently existing in the quantities themselves.

The chronograph was brought into use during the year 1854.

Table II.

Table of adopted corrections to reduce the adopted Clock-Star Lists, 1836–1895, to the Right Ascensions of the Five-Year Catalogue, 1890.

Year.	Corr. s	Year.	Corr. s
1836	−·020	1846	+·060
1837	−·013	1847	+·078
1838	−·015	1848	+·078
1839	−·001	1849–1855	+·011
1840	−·000	1856–1861	+·002
1841	−·008	1862–1869	+·005
1842	−·001	1870–1877	+·013
1843	+·076	1878–1888	·000
1844	+·083	1889–1895	·000
1845	+·089	...	...

These quantities with sign changed are directly applicable (see *M. N.* liv. p. 417) to the quantities given in the introductions to the several catalogues as corrections to the right ascensions of clock-stars from discussions of the position of the ecliptic, and these quantities thus corrected are given in the following table.

For the years 1836–1863 the places of the Sun were computed from Carlini's Tables; from 1865–1895 from those of Le Verrier :—

TABLE III.

Table of corrections to a system of Right Ascensions of Clock-Stars depending on the position of the Five-Year Catalogue, 1890, from observations of the Sun for the years 1836–1895.

Year.	Corr. s	Year.	Corr. s	Year.	Corr. s	Year.	Corr. s
1836	−0·11	1851	−0·03	1866	−0·01	1881	−0·04
1837	− ·03	1852	+ ·02	1867	− ·05	1882	− ·03
1838	− ·12	1853	+ ·01	1868	− ·05	1883	·00
1839	− ·07	1854	+ ·05	1869	·00	1884	+ ·08
1840	− ·09	1855	− ·02	1870	− ·02	1885	− ·01
1841	− ·01	1856	− ·07	1871	+ ·03	1886	+ ·09
1842	− ·05	1857	− ·02	1872	− ·03	1887	− ·06
1843	+ ·03	1858	− ·03	1873	+ ·05	1888	+ ·07
1844	− ·07	1859	+ ·04	1874	− ·06	1889	+ ·02
1845	+ ·00	1860	− ·02	1875	+ ·03	1890	+ ·09
1846	+ ·03	1861	·00	1876	+ ·04	1891	+ ·09
1847	− ·04	1862	− ·01	1877	+ ·02	1892	+ ·04
1848	+ ·11	1863	+ ·01	1878	− ·05	1893	+ ·09
1849	− ·05	1864	·00	1879	+ ·03	1894	+ ·04
1850	− ·08	1865	− ·01	1880	− ·09	1895	+ ·03

The mean of these corrections is

$$-0^{s}\cdot005 \pm 0\cdot0047,$$

and the probable error of a single determination is

$$\pm 0^{s}\cdot035.$$

The true value of this correction being of the form

$$x + yT = \text{annual correction},$$

where T is the fraction of a century from the adopted epoch 1880, the solution of the sixty resulting equations by the method of least squares gives the following normal equations :

$$60\,x - 8\cdot70\,y = -0\cdot29 \quad (s)$$

$$-8\cdot70\,x + 3\cdot07\,y = +0\cdot30,$$

whence

$$x = +0^{s}\cdot015 \qquad y = +0^{s}\cdot132.$$

The quantities in Table III., arranged in series of ten years, show as follows :—

1836.	1837.	1838.	1839.	1840.	1841.	1842.	1843.	1844.	1845.
$-^{s}\cdot005$	$-^{s}\cdot030$	$-^{s}\cdot012$*	$-^{s}\cdot005$	$-^{s}\cdot035$	$+^{s}\cdot007$	$-^{s}\cdot008$	$+^{s}\cdot030$	$+^{s}\cdot008$	$+\cdot003$

* Excluding the result for 1848, which is somewhat anomalous, the result would be $-^{s}\cdot030$.

This apparent period may be purely accidental, but a correction may be fairly represented by the expression

$$+0^{s}\cdot02 \cos (T-1844)\, 36^{\circ}.$$

As the accidental errors existing in the correction to the right ascensions of the clock-stars derived from the discussions of the position of the ecliptic appear to be large, it would seem inexpedient to refer catalogues extending over a short period of time directly to the corresponding observations of the Sun in preference to basing the right ascensions on a well-determined system of clock-stars.

As an instance of the uncertainty of the actual value of this correction, the 1840 and 1845 Greenwich Catalogues afford instructive examples, for in the Introduction it is shown that after the clock-stars have been all reduced to the same system, the correction for epoch for the years 1836–41 is $-0^{s}\cdot110$, and for the years 1842–48 is $-0^{s}\cdot043$.

On the Proper Motion of B.D.+25°, No. 2874.

By Walter W. Bryant.

This star is a wide companion of *c Boötis*, which appears in most catalogues with a well-determined P.M. of $+0^{s}\cdot0116$ in R.A. and $+0''\cdot191$ in N.P.D.

Baron d'Engelhardt measured this among his Bradley's wide pairs, and from his observations, made in 1887 and 1889, suspected that the faint star had also a P.M. Finding a meridian observation of the star in B.D. (vol. vi.), which confirmed this view, he wrote to Professor Schönfeld, who assured him that he had no reason to suspect the accuracy of the Bonn observation.

Combining this with his own observations, the Baron obtained for this star a P.M. of $-0^{s}\cdot0642$ in R.A. and $-0''\cdot408$ in N.P.D. He notes the magnitude as 9·5 (fainter than 9·2 given in B.D. But being apparently desirous to risk nothing on the accuracy of a single meridian observation, he continued his measures in 1893 and 1895, and from his own sets (11 measures in all) he obtained a revised value of P.M. in R.A. $-0^{s}\cdot0666$, and in N.P.D. $-0''\cdot631$.